Section 604. CONTRACTOR QUALITY CONTROL FOR CONCRETE

604.01 Description. The Contractor shall provide quality control for concrete adequate to produce work of acceptable quality. The Contractor shall perform quality control sampling, testing, and inspection during all phases of the concrete work at the minimum rate specified.

The Engineer will not sample or test for quality control or assist in controlling the Contractor's production operations. The Contractor shall provide the personnel and testing equipment capable of performing the specified tests, interpreting results and making required adjustments to the mix. Continual production of nonconforming work at a reduced price, in lieu of making adjustments to bring work into conformance, will not be allowed.

604.02 Materials. None specified.

604.03 Quality Control Considerations.

A. **Quality Control Plan.** The Contractor shall provide and maintain a quality control plan, listing all the personnel, equipment, supplies, and facilities necessary to obtain samples, perform tests, and otherwise control the quality of the product to meet specifications. The quality control plan shall specify a random method of sampling that assures all material being produced has an equal chance of being selected for testing. The method described in the *Materials Quality Assurance Manual* is an acceptable alternative. The plan must specify what actions will be taken when test results identify concrete that is not in compliance with the specifications. The Engineer shall be provided the opportunity to witness all sampling and testing. The Contractor shall certify in writing to the Engineer that the testing equipment to be used is properly calibrated. Calibration data and correction factor information shall be included in the quality control plan.

   The quality control plan shall be administered by a qualified individual. The individual administering the plan must be a full-time employee of or a consultant engaged by the Contractor. The individual shall have full authority to institute any and all actions necessary for the successful implementation of the quality control plan.

   The Contractor shall maintain complete records of all quality control tests and inspections. These records shall indicate what action was taken to correct deficient concrete when quality control tests indicate the concrete was not in compliance with the specifications. The original and one copy of these records shall be furnished to the Engineer within 24 hours after the date covered by the record. Reports shall be in a format acceptable to the Engineer.

   All quality control test reports or other records shall include sufficient information to allow the test results to be correlated with the items of work represented. If this work is covered by the Department’s Concrete Quality Assurance program, all records shall include the lot identification number which coincides with the appropriate quality assurance lot identification number. This will allow all information to be correlated if a dispute arises. Failure of the Contractor to provide properly documented quality control test results in a timely manner will be justification for withholding acceptance of the concrete product.

The Contractor shall submit the quality control plan for the appropriate items to the Engineer for review a minimum of ten working days prior to the start of related work. The Contractor shall not begin concrete placement prior to acceptance of the quality control plan by the Engineer. The Engineer will review and notify the Contractor of any objections within five days of receipt of the plan.

B. **Qualifications.** The individual administering the quality control plan shall meet at least one of the following criteria: a Professional Engineer licensed in the State of Michigan; certified by the National Institute for Certification of Engineering Technologies (NICET) at Level III or above for concrete; certified as a Concrete Technician Michigan Level II through a program certified by Michigan Concrete Association Board of Examiners or the Michigan Concrete Paving Association.

The individual(s) performing designated tests shall be certified as Concrete Technician(s) through a program certified by the Michigan Concrete Association (Michigan Level I or II) or through the Michigan Concrete Paving Association (Level I or II - three year certification).

The Contractor shall furnish the name(s) and credentials of the quality control staff to the Engineer prior to the start of concrete sampling and testing.

C. **Sampling and Testing.** Sampling and testing shall be performed in accordance with the following minimum frequencies and specifications.

NOTE: When directed by the Engineer, the Contractor shall sample and test any material which appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or corrected by the Contractor.

1. **Concrete Yield Determination.** After the start of the first concreting operation for each mix design and immediately after the specified slump and entrained air have been attained, unit weight determinations shall be made by the Contractor, under the direction of the Engineer. The average of the three determinations from different batches shall be considered the unit weight of the concrete. The actual yield shall be determined from the average unit weight and the design mix shall be adjusted as required to correct the actual yield to correspond to the theoretical yield.

   During the progress of the work, the actual yield may be verified and, if the yield based on a single unit weight determination should differ from the theoretical (adjusted for differences in air content) more than plus two percent or minus zero percent, two additional unit weight determinations shall be made by the Contractor and the average of the three determinations shall be considered the unit weight of the concrete. The actual yield shall be determined from the average unit weight, and the design mix shall again be adjusted as required to correct the actual yield to correspond to the theoretical yield.

2. **Concrete Temperature, Slump and Air Content Determination.** The Contractor shall perform sampling and testing for temperature, slump, and air content on the first load, and, if directed by the Engineer, subsequent loads for each grade of concrete delivered

to the worksite each day. Concrete placement shall not begin until the Contractor's quality control test verify that the concrete meets required specifications.

During concrete placement the Contractor must test for temperature, slump and air content of the concrete at a minimum rate of once per hour. Quality control tests may coincide with the tests required to be performed on the samples from which acceptance cylinders are molded. If this occurs, the tests do not need to be duplicated. Instead, the Contractor's quality control test results for temperature, slump, and air content will be recorded for the quality assurance test cylinders.

3. **Concrete Strength Determination.** The Contractor shall determine the concrete strength on samples taken at least once every 200 cubic yards of a specific mix design, except that no less than one or more than four samples, evenly spread throughout the day, need to be taken for one day's production of the mix. Compressive strength or modulus of rupture may be used for strength determination. A single strength test shall consist of two cylinders or two beams.

4. **Concrete Containing Fly Ash.** For concrete Grade D containing fly ash, a Certified Concrete Technician Michigan Level II inspector shall be provided by the Contractor to perform all testing. The air content of each load or batch shall be determined and found to be within the specified range before the concrete is placed in the bridge deck.

5. **Test Procedure Specifications.**

   ASTM

C31	Making and Curing Concrete Test Specimens in the Field
C39	Compressive Strength of Cylindrical Concrete Specimens
C78	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
C138	Unit Weight, Yield and Air Content (Gravimetric) of Concrete
C143	Slump of Hydraulic Cement Concrete
C172	Sampling Freshly Mixed Concrete
C173	Air Content of Freshly Mixed Concrete by the Volumetric Method
C231	Air Content of Freshly Mixed Concrete by the Pressure Method
C293	Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)

   The Department's established procedures for sampling and testing are considered acceptable alternatives.

604.04 Measurement and Payment. Separate payment will not be made for providing and maintaining an effective quality control program, and all costs associated with this work shall be included in the applicable unit prices for the concrete item.